# Assessment of Sediment Toxicity in Galveston Bay, Texas

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NOAA's National Status and Trends Program estimates the spatial extent of coastal environmental degradation due to contamination by toxic chemicals, using a series of regional studies as a basis for integration on a national scale. As part of the program, sediment toxicity in Galveston Bay, Texas was studied in August, 1996.

Stations were selected based on a stratified-random design. Figure one illustrates the location of the seventy-five stations and the strata delineation. The strata were defined based on physiographic features, oceanographic regimes, and/or resource management considerations. The sampling area encompassed 1351 $km^2$, from San Jacinto State Park southward to, and including, the immediate waters of the Gulf of Mexico. The sediment quality triad (SQT) concept was used as an effects based approach to assessing the degree and extent of toxicant induced habitat degradation. The three components of SQT are: (1) assessing chemical contaminant concentrations of over 70 analytes, including heavy metals, polychlorinated biphenyls, pesticides, and polynuclear aromatic hydrocarbons in the surficial layer of sediment; (2) sediment toxicity testing, including a 10 day amphipod survival test done with whole sediment, a sea urchin fertilization and 48 hour embryonic development test done with porewater, and Microtox™ response and P450 Reporter Gene System tests done with organic extracts; and (3) benthic macroinvertebrate community characterization.

Preliminary data show that among the toxicity tests used, the Microtox™ response (*Photobacterium phosphoreum*) was the most pervasive, notably in the upper reaches of the bay and in West Bay. Fifty-nine of the seventy five stations sampled were significantly toxic. A similar toxicity pattern, but at fewer sites, was evident from the results of the sea urchin (*Arbacia punctulata*) fertilization and embryological development tests. Significant toxicity at 100 percent porewater concentrations occurred in 40 and 34 stations for the fertilization and development tests, respectively. The number of significantly toxic stations decreased accordingly as the porewater was diluted to 50 and 25 percent. No toxicity could be inferred from the amphipod (*Ampelisca abdita*) survival test. The percent survival ranged from 88 to 100. This pattern of sediment toxicity is coincident with results of the Reporter Gene System (RGS) bioassay that showed generally higher values in the northern portion of the bay, but the values were lower than those associated with impaired benthic community structure. The benthic macrofauna taxa consisted of 46.5% *Annelida*, 23.7% *Mollusca*, 23.3% *Crustacea*, 0.5% *Rhynchocoela*, and 6.2% other taxa. The highest faunal densities occurred in Trinity and West Bays. Trace metal and organic compound concentrations did not follow this pattern as closely. Numerous stations throughout the Bay exceeded the ER-L sediment quality guidelines for both trace metals and organic compunds but only two of the seventy-five stations exceeded an ER-M sediment quality guideline. Table one provides the range of concentrations, the mean concentrations and standard deviations and ER-L and ER-M values for selected analytes. Further analyses of data continue, including distribution patterns among sediment toxicity, benthic fauna, and levels of contaminants in sediment.

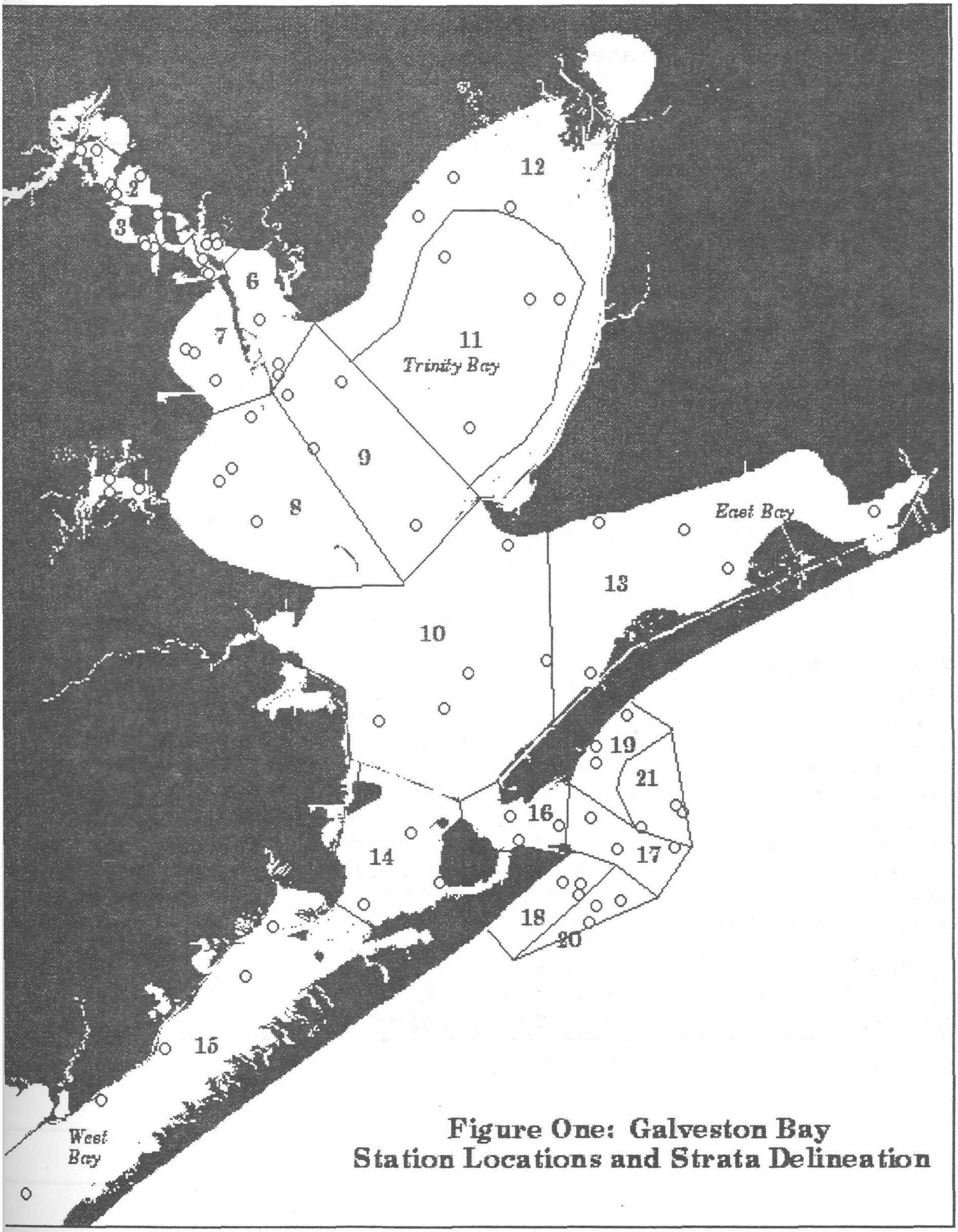


**Figure One: Galveston Bay Station Locations and Strata Delineation**

**Table One**: Selected Chemical Contaminant Concentrations in Galveston Bay and associated Sediment Quality Guidelines.

| Heavy Metal | Range of Concentrations | Mean Concentration ± stdev | ERL (ppm, dry wt.) | ERM (ppm, dry wt.) |
|---|---|---|---|---|
| Arsenic | ND - 13.35 | 5.91 ± 3.40 | 8.2 | 70 |
| Cadmium | 0.01 - 0.21 | 0.09 ± 0.056 | 1.2 | 9.6 |
| Chromium | 3.44 - 84.13 | 41.03 ± 18.55 | 81 | 370 |
| Copper | 1.61 - 33.22 | 10.72 ± 6.32 | 34 | 270 |
| Lead | 5.72 - 37.7 | 16.85 ± 6.41 | 46.7 | 218 |
| Mercury | ND - 0.17 | 0.05 ± 0.032 | 0.15 | 0.71 |
| Nickel | ND - 28.95 | 15.09 ± 7.4 | 20.9 | 51.6 |
| Silver | 0.04 - 0.52 | 0.12 ± 0.06 | 1.0 | 3.7 |
| Zinc | 6.77 - 167.57 | 65.8 ± 31.92 | 150 | 410 |
| **Organic Compounds** | **Range of Concentrations** | **Mean Concentration ± stdev** | **ERL (ppb, dry wt.)** | **ERM (ppb, dry wt.)** |
| Acenaphthene | 0.2 - 34.9 | 1.8 ± 4.54 | 16 | 500 |
| Acenaphthylene | ND - 26.6 | 3.1 ± 4.24 | 44 | 640 |
| Anthracene | 0.1 - 228.3 | 8.8 ± 28.38 | 85.3 | 1100 |
| Fluorene | 0.2 - 34.5 | 2.4 ± 5.15 | 19 | 540 |
| 2Methyl naphthalene | 0.2 - 11.0 | 2.4 ± 2.12 | 70 | 670 |
| Naphthalene | 0.5 - 18.4 | 4.2 ± 2.72 | 160 | 2100 |
| Phenanthrene | 0.2 - 501.5 | 13.6 ± 59.10 | 240 | 1500 |
| Low molecular wt. PAH | 4.3 - 1944.8 | 138.4 ± 254.71 | 552 | 3160 |
| Benzo(a)anthracene | 0.1 - 676.4 | 19.1 ± 78.79 | 261 | 1600 |
| Benzo(a)pyrene | 0.1 - 335.3 | 16.0 ± 41.46 | 430 | 1600 |
| Chrysene | 0.1 - 711.6 | 22.8 ± 83.85 | 384 | 2800 |
| Dibenz(a,h)anthracene | ND - 66.1 | 3.5 ± 8.29 | 63.4 | 260 |
| Fluoranthene | 0.1 - 1473.0 | 38.6 ± 170.85 | 600 | 5100 |
| Pyrene | 0.2 - 1502.7 | 43.8 ± 175.03 | 665 | 2600 |
| High molecular wt. PAH | 1.5 - 8393.3 | 317.6 ± 993.01 | 1700 | 9600 |
| total PAH | 5.4 - 10586.7 | 468.4 ± 1262.78 | 4022 | 44792 |
| p,p'DDE | ND - 2.16 | 0.13 ± 0.30 | 2.2 | 27 |
| total DDT | ND - 451.54 | 7.37 ± 52.32 | 1.58 | 46.1 |
| total PCBs | 2.27 - 60.79 | 7.61 ± 8.60 | 22.7 | 180 |